

APPENDIX D
Clean Air Act General Conformity Analysis

**SUB-AREA MASTER PLAN REVISIONS AT FORT BELVOIR, VIRGINIA
CLEAN AIR ACT CONFORMITY ANALYSIS**

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APPENDIX A: DETAILED EMISSION CALCULATIONS

LIST OF ABBREVIATIONS

CAA	Clean Air Act
CFR	Code of Federal Regulations
CO	Carbon Monoxide
GCR	General Conformity Rule
HC	Hydrocarbons
MP	Military Police
mmBtu	Million British Thermal Units
mph	Miles Per Hour
MWR	Morale, Welfare and Recreation
NAAQS	National Ambient Air Quality Standards
NCPC	National Capital Planning Commission
NCR	North Capital Region
NO _x	Oxides of Nitrogen
NSR	Non-Attainment New Source Review
O ₃	Ozone
Pb	Airborne Lead
PM	Particulate Matter
PM _{2.5}	Particulate Matter with an Equivalent Aerodynamic Diameter Less Than 2.5 um
PM ₁₀	Particulate Matter with an Equivalent Aerodynamic Diameter Less Than 10 um
PSD	Prevention of Significant Deterioration
PX	Post Exchange
RCSC	Regional Community Support Center
SIP	State Implementation Plan
SO ₂	Sulfur Dioxide
TPY	Tons Per Year
USEPA	United States Environmental Protection Agency
VDEQ	Virginia Department of Environmental Quality
VOC	Volatile Organic Compounds

SECTION 1 INTRODUCTION

Woolpert LLP (Woolpert) has retained the services of The Louis Berger Group, Inc. (Berger), to perform a conformity determination with respect to proposed revisions to the sub-area master plan for the Regional Community Support Center for Fort Belvoir, Virginia. The U.S. Army's Fort Belvoir desires to update the sub-area master plan for the North Post Regional Community Support Center (RCSC) to address anticipated growth, proposals for new support facilities and redirection of the functional elements reflected in the existing sub-area master plan. The project includes a new hospital, military police (MP) station, chapel, and soldier support building. In support of the environmental assessment being prepared, Berger is performing a conformity determination for the proposed project, per the provisions of 40 CFR 93.150 and Virginia DEQ provisions for General Conformity (9 VAC 5 Chapter 160).

1.1 Description of Project

In 1993, Fort Belvoir developed a sub-area master plan for a portion of the North Post RCSC. The purpose of the RCSC is to provide functions and amenities found in a town center. The RCSC concept provides for exchange services, commissary services, banking, dining, and Morale, Welfare and Recreation (MWR) related activities. The North Post RCSC is intended to be a focal point for community activities for the Fort Belvoir community and the large Army community residing in the National Capital Region (NCR).

The North Post Regional Community Support Center is bounded by John J. Kingman Road to the north, Woodlawn Road to the east, Abbot Road to the south and Gunston Road to the west. Additionally, there is a peninsula of land appended to the south that is designated as "office park." This "office park" area is bounded by Abbot Road to the north, Woodlawn Road to the east, Lambert Road to the south and Franklin Road to the west. The revision of the North Post RCSC sub-area master plan and its components must be completed, submitted to the National Capital Planning Commission (NCPC), and approved by NCPC no later than September 2002.

1.2 Clean Air Conformity

The 1990 amendments to the Clean Air Act (CAA) require federal agencies to conform to State Implementation Plans (SIPs) in non-attainment areas. SIPs are state air quality regulations that provide for the implementation, maintenance, and enforcement of the National Ambient Air Quality Standards (NAAQS) and include emission limitations and control measures to attain and maintain the NAAQS. Federal agencies are required to determine if proposed actions conform to the applicable SIP.

The US Environmental Protection Agency (USEPA) has developed two conformity regulations for transportation and non-transportation projects. Transportation projects are governed by the "transportation conformity" regulations (40 CFR Parts 51 and 93). Non-transportation projects are governed by the "general conformity" regulations (40 CFR

Parts 6, 51 and 93) described in the final rule for *Determining Conformity of General Federal Actions to State or Federal Implementation Plans*. Since the proposed project is a non-transportation project, only the general conformity rule applies. This general conformity applicability analysis is prepared as a supplement to the Environmental Assessment for the sub area master plan update and for Virginia Regulation For General Conformity (9 VAC 5 Chapter 160).

SECTION 2 GENERAL CONFORMITY

2.1 Attainment and Non-attainment Areas

The General Conformity Rule applies to federal actions occurring in air quality regions designated as being in non-attainment for the NAAQS or attainment areas subject to maintenance plans (maintenance areas). Federal actions occurring in attainment areas are not subject to the conformity rules.

A criteria pollutant is a pollutant for which an air quality standard has been established under the CAA. Under the requirements of the 1970 Clean Air Act (CAA), as amended in 1977 and 1990, the USEPA established standards, known as the NAAQS, for six criteria pollutants: carbon monoxide (CO), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), ozone (O₃), inhalable particulate matter (PM₁₀ and PM_{2.5}), and lead (Pb).

Non-attainment designation is based on the exceedances or violations of the air quality standard. A maintenance plan establishes measures to control emissions so as to ensure that the air quality standard is maintained in areas that have been redesignated as attainment from a previous non-attainment status. The proposed action would take place in Fort Belvoir, Fairfax County, VA, which is located in an area currently designated as in serious non-attainment for O₃ and in attainment for the other criteria pollutants. O₃ is principally formed through chemical reactions of NO_x and VOC in the atmosphere therefore, only emissions of NO_x and VOC are included in the analysis.

2.2 De Minimis Emission Levels

Threshold (*de minimis*) rates of emissions have been established for federal actions with the potential to have significant air quality impacts. A formal conformity determination is required when the annual direct and indirect emissions from a federal action, occurring in a non-attainment or maintenance area, equals or exceeds the *de minimis* level. Table 2-1 lists the *de minimis* levels by pollutant. Since the project is located in a serious O₃ non-attainment area, only the 50 tons per year of VOC or NO_x threshold applies.

2.3 Regional Significance

A federal action that does not exceed the threshold emission rates of criteria pollutants may still be subject to a general conformity determination if the direct and indirect emissions from the action exceed ten percent of the total emissions inventory for a particular criteria pollutant in a non-attainment or maintenance area. If the emissions exceed this ten-percent threshold, the federal action is considered to be a “regionally significant” activity, and thus, the general conformity rules apply.

2.4 Analysis Methodology

Per the provisions of 40 CFR 93.150, federal agencies are required to perform a conformity determination when the emissions in non-attainment or maintenance areas would total or exceed thresholds emission levels. "Federal action", as defined in the Virginia General Conformity Rules (GCR) means any activity engaged in by a federal agency, or any activity that a federal agency supports in any way, provides financial assistance for, licenses, permits, or approves, other than activities related to transportation plans, programs, and projects developed, funded, or approved under Title 23 USC or the Federal Transit Act (49 USC §5301 et seq.). Therefore, the proposed action is defined as activities related to the North Post RCSC Expansion.

The proposed action would be subject to conformity requirements if emissions of VOC or NO_x exceed 50 tons per year. Other pollutants do not need to be included in the conformity analysis since the area is designated as attainment or unclassifiable for all other criteria pollutants. A detailed analysis of emissions related to this project is presented in Section 3.

2.5 Potential Other Regulatory Requirements

In addition to potential conformity requirements for the proposed project, emissions sources to be constructed as part of the North Post RCSC will likely be subject to Non-Attainment New Source Review (NSR), Prevention of Significant Deterioration (PSD) and other federal, state and local air pollution control requirements. Since the applicability of these requirements is based upon facility-wide net emissions increases, an applicability analysis for these regulations has not been incorporated into this analysis. However, an applicability determination for these regulations, as well as a formal facility-wide emission netting analysis, will likely be required as part of pre-construction permitting activities for the project. These activities will occur after approval of the conformity analysis.

Table 2-1
De Minimis Emission Levels for Applicable Air Pollutants

Pollutant	Non-attainment Designation	TPY
Ozone	Serious	50
	Severe	25
	Extreme	10
	Other non-attainment areas outside ozone transport region	100*
	Marginal and moderate non-attainment areas inside ozone transport region	50/100**
Carbon Monoxide	All	100
Sulfur Dioxide	All	100
Lead	All	25
Nitrogen Dioxide	All	100
Particulate Matter	Moderate	100
	Serious	70

Notes:

* Applies to ozone precursors – volatile organic compounds (VOC) and nitrogen oxides.(NO_x)

** VOC/NO_x

*** Fairfax County has a non-attainment designation of serious for Ozone

SECTION 3 ANALYSIS

The conformity analysis for a federal action examines the impacts of the direct and indirect net emissions from mobile and stationary sources. Direct emissions are emissions of a criteria pollutant or its precursors that are caused or initiated by a federal action and occur at the same time and place as the action. Indirect emissions, occurring later in time and/or further removed in distance from the action itself, must be included in the determination if both of the followings apply; the federal agency can practicably control the emissions and has continuing program responsibility to maintain control and the emissions caused by the federal action are reasonably foreseeable.

3.1 Operational Activities

After implementation of the proposed action, the new buildings would contain a number of natural gas and fuel oil fired combustion units (i.e. boilers and space heaters) for heat and steam. In addition, the proposed hospital would also operate three emergency generators to provide electricity during power outages. Therefore, there will be a net increase in the post emissions due to these sources.

Emissions from these sources have been estimated based upon potential fuel usage calculated from information provided by the project designers. In general, potential emissions have been estimated by multiplying the maximum annual fuel usages by the conservative emission factors presented in the USEPA guidance document AP-42. For the proposed hospital boilers, emission estimates assumes a maximum of 20% annual fuel oil usage. In addition, annual emissions from emergency generators are calculated based upon an annual dispatch of 500 hours per year per USEPA guidance. Potential emissions from these hospital boilers will be limited by conditions of air permit required for installation and operating.

Additional calculations were performed for combustion units at the Military Police Station, the Chapel, the Post Exchange, and the Soldier Support Building. AP-42 factors for small natural gas combustion sources were used to estimate combustion sources. Annual fuel consumption for the Post Exchange Expansion, the Chapel and the Soldier Support Center were estimated using Btu/ft² factors from Fort Hamilton, NY. Design hourly heat output was used to estimate annual consumption for the Military Police Station. These methods provide an order of magnitude estimate of air emissions from proposed operations. The capacity/number of installed unit(s) may differ based upon final decision.

Traffic emissions do not need to be included since there is no net increase in passenger trips for the project. The proposed projects relocate existing operations therefore, vehicular NO_x and VOC emissions are not expected to increase.

A summary of the emission estimates for operational sources is presented in Table 3-1. Detailed emission calculations for these sources are presented in Appendix A.

3.2 Construction Activities

Construction activities-related air emissions were analyzed. Increased direct and indirect VOC and NO_x emissions from construction would result from the following potential activities:

- Use of construction equipment.
- Movement of trucks containing construction materials.
- Use of paving equipment.
- Construction workers commutes.

In estimating NO_x and VOC emissions from construction activities, the usage of equipment and the duration of activities for construction were first determined based on the size of building structure and parking lot to be constructed. The increase in emissions was then calculated using the USEPA provided guidance and emission factors.

3.3 Emissions Determination

The General Conformity Rule (GCR) requires that potential emissions generated by any project-related demolition or construction activity and/or increased operational activities be determined on an annual basis and compared to the annual *de minimis* levels for those pollutants (or their precursors) for which the area is classified as non-attainment or maintenance. Emissions attributable to operational activities and construction were analyzed for NO_x and VOC.

In estimating operational-related boiler, space heater, and generator emissions, the USEPA-developed AP-42 emission factors were used if other emissions information was not provided. Emissions from the operation of the equipment are assumed to be released after construction of the new facility is completed in 2005.

In estimating construction-related NO_x and VOC emissions, the usage of equipment, the likely duration of each activity, and manpower estimates for each activity for the construction were determined based on the Heavy Construction Cost Data (Means 2000) and the past field experience for similar types of demolition and construction projects. The weekly duration given for each activity is assumed to be eight hours per day and five days per week.

A summary of emission estimated summarized below are presented in Table 3-1.

3.3.1 Operational Activities

Emissions from operational activities proposed as part of this process consist of three categories of equipment; boilers, space heaters and emergency generators. Detailed methodology presented in section 3.1.

For the proposed hospital, equipment operating parameters were based upon conservative estimates provided by the design engineering firm. For building space heaters, operational parameters were estimated based upon the building area. Complete details of emissions calculations used in the analysis are presented in Appendix A.

3.3.2 Construction Activities

Construction of the proposed North Post RCSC would include equipment mobilization, site preparation, foundations, exterior masonry work, interior and exterior utilities and exterior pavement around buildings. Therefore, construction activities would involve operations of 1) on-site construction equipment and 2) motor vehicles including construction material delivery trucks and workers commuting vehicles. Since the maximum annual emissions would result from all projects being constructed at the same time, the number and type of equipment necessary for construction activities were determined in aggregate for the project. All equipment was assumed to be diesel-powered unless otherwise noted. Each piece of equipment is assumed to be operated continuously for 75 percent of the time during each working day, which is equivalent to six hours per day. Pieces of equipment to be used for each building to be constructed include, but are not limited to; bull dozers, backhoes, dump trucks, front-end loaders, jackhammers and gas engine vibrators.

Estimates of construction equipment emissions were based on the estimated hours of usage and emission factors for each motorized source for the project. Emission factors for NO_x and VOC related to heavy-duty diesel equipment were obtained from *Non-Road Engine and Vehicle Emission Study B Report* (USEPA, 1991). Emission factors are available for hydrocarbons (HC), which include all VOC as well as other non-VOC constituents; therefore, HC emissions represent a conservative estimate of VOC emissions.

Emission factors in grams of pollutant per hour per horsepower were multiplied by the estimated running time and equipment associated average horsepower provided by the USEPA to calculate total grams of pollutant from each piece of equipment. Finally, these total grams of pollutant were converted to tons of pollutant.

The USEPA recommends the following formula to calculate hourly emissions from nonroad engine sources:

$$M_i = N \times HP \times LF \times E_{Fi}$$

Where:

M_i = mass of emissions of pollutants.

N = source population (units).

HP = average rated horsepower.

LF = typical load factor.

E_{Fi} = average emissions of pollutant per unit of use (e.g., grams per horsepower-hour).

Estimated emissions from onsite building construction are presented in Appendix A. It is assumed that most of the building construction would take place in 2003-2004. Therefore emission estimates are evenly split between these two years.

The personnel needed for the construction would include foremen, equipment operators, plumbers, electricians, landscapers, truck drivers and utility installation crew, etc. Based on crews information from Means (2000) and field experience from similar type of construction projects, the crew members time for each task were estimated assuming each of the identified work would be conducted in sequence without overlapping.

3.3.3 Construction Motor Vehicle Operations and Emissions

Truck and commuting vehicle operations would result in indirect emissions. However, the only activities that are subject to the general conformity determination include vehicle operations within Fort Belvoir, over which the US Army Garrison would have control. Motor vehicle operations within Fort Belvoir are assumed to be as follows:

- Pickup and dump trucks would travel at an average speed of 25 miles per hour (mph) on site, for a total estimated run time of four hours per working day.
- Each commuter vehicle would make a 20-minute round trip within Fort Belvoir at an average speed of 25 mph.

Emission factors for motor vehicles were calculated for 2003 for both dump trucks (heavy duty diesel vehicles) and commuter vehicles (light duty gasoline vehicles) using the USEPA Mobile5b mobile source emission factor model associated with input parameters provided by the MWCOG for an O₃ season that is applicable to the Fairfax County area.

3.4 Regional Significance

The *Final State Implementation Plan Revision, Phase I Attainment Plan* (MWCOG, October, 1997) sets forth daily target levels of 362.9 tons per day (tpd) of VOC and 637.1 tpd of NO_x for the Washington Metropolitan ozone non-attainment area where the Fairfax County area is included, the increase in annual emissions would not make up ten percent or more of the available regional emission inventory for VOC or NO_x and would not be regionally significant.

Table 3-1
Summary of Emissions

Pollutant	Operational Sources	Construction Sources	Totals
Volatile Organic Compounds	1.8	0.7	2.6
Oxides of Nitrogen	28.5	6.3	34.8

Notes:

- 1) Detailed calculations are presented in Appendix A.

SECTION 4 CONCLUSION

Under the general conformity rule, emissions resulting from proposed federal action must be compared to the applicable *de minimis* levels on an annual basis. Total annual emissions were determined for the Proposed Action based on the mobile-source emissions during operation and construction and are summarized in the previous section. As defined by the general conformity rule, if the emissions of a criteria pollutant (or its precursors) do not exceed the *de minimis* level, the federal action has minimal air quality impact and therefore the action is determined to conform for the pollutant under study and no further analysis is necessary. Conversely, if the total direct and indirect emissions of a pollutant are above the *de minimis* level, a formal general conformity determination is applicable for that pollutant in order to determine air quality impact significance.

As shown in this analysis, the emission values for the Proposed Action would not exceed the *de minimis* criteria of 50 TPY of VOC or NO_x, therefore a formal conformity determination is not required.

APPENDIX A
DETAILED EMISSION CALCULATIONS

FIGURE A-1
PROJECT EMISSIONS SUMMARY

Annual Emissions (tons/year)								
Pollutant	Hospital Boilers	Emergency Generators	Military Police Station	Chapel	Soldier Support Center	Construction Activities	Post Exchange	Facility-Wide Total
	A-2	A-3	A-4	A-5	A-6	A-7	A-8	tons/year
VOC	0.20	0.83	0.01	0.10	0.35	0.73	0.36	2.57
NOx	3.44	10.11	0.21	1.89	6.32	6.27	6.51	34.75
CO	3.01	2.18	0.17	1.59	5.31		5.47	17.73
SO2	0.83	0.66	0.00	0.01	0.04		0.04	1.59
PM/PM10	0.40	0.71	0.02	0.14	0.48		0.49	2.25
Lead	2.41E-05	0.00E+00	1.03E-06	9.44E-06	3.16E-05		3.26E-05	9.87E-05

NOTES:

*1

Please refer to individual spreadsheets for detailed emission estimates

*2

Since the proposed project will not result in any impacts to vehicle trips, no increase in emissions associated with transportation sources have been included in the determination.

FIGURE A-2
POTENTIAL EMISSION ESTIMATES FOR PROPOSED HOSPITAL BOILERS

EMISSIONS CALCULATIONS BASED UPON AP-42 EMISSION FACTORS

POTENTIAL DISPATCH

7.16.E+10 Annual Fuel Input, Btu/yr

NATURAL GAS Heat Capacity = 1,000 Btu/CF
 Annual Maximum Fuel Usage (No Oil) 71.6 mmCF/yr, or
 Annual Maximum Fuel Usage (With Oil) 57.3 mmCF/yr.

NO. 2 FUEL OIL Heat Capacity = 142,000 Btu/gal
 Annual Maximum Fuel Usage (No Oil) 57.6 mgal/yr.
 Sulfur In Fuel Oil = 0.2 % by weight

Pollutant Emissions	Emission Factors ^{*1,*2}				Actual Emissions (tons/year)
	Natural Gas		No. 2 Fuel Oil		
	(lb/mmCF)	(lb/mmBtu)	(lb/mgal)	(lb/mmBtu)	
VOC	5.5	0.0055	0.34	0.0024	0.20
NO _x	100	0.10	20	0.141	3.44
CO	84	0.084	5	0.035	3.01
SO ₂	0.6	0.0006	28.4	0.20	0.83
PM/PM ₁₀	7.6	0.0076	6.36	0.045	0.40
Lead	0.0005	0.0000005	0.00034	2.39E-06	2.4E-05

Notes:

- *1 Emission factors for natural gas and fuel oil combustion based upon values presented in the USEPA reference document AP-42 Sections 1.4 and 1.3, respectively.
- *2 Emissions rates calculated based upon the following equation:

 Emissions (tons/year) = [(Natural Gas Usage * Emission Factor) + (Fuel Oil Usage * Emission Factor)] / 2,000 lb/ton
- *3 For pollutants with a higher fuel oil emissions factor (i.e. NO_x, SO₂, PM/PM₁₀ and Lead) emissions incorporate the maximum oil usage and natural gas usage with oil presented above.
- *4 For pollutants with a higher natural gas emissions factor (i.e. VOC and CO), emission estimates incorporate only the natural gas usage presented above.
- *5 Annual fuel usage based upon information provided by design engineer.

FIGURE A-3
POTENTIAL EMISSION CALCULATIONS FOR EMERGENCY GENERATOR

EMISSIONS CALCULATIONS BASED UPON AP-42 EMISSION FACTORS

POTENTIAL DISPATCH

4.58.E+09 Annual Fuel Input, Btu/yr

Pollutant Emissions	Emission Factors (lb/mmBtu)		Potential Emissions (tons/year)
VOC	0.36		0.83
NO_x	4.41		10.1
CO	0.95		2.2
SO₂	0.29		0.66
PM/PM₁₀	0.31		0.71

Notes:

- *1 Emission factors for diesel fired emergency generators are based upon values presented in the USEPA reference document AP-42 Section 3.4.
- *2 Emissions rates calculated based upon the following equation:

$$\text{Emission Rate (TPY)} = \text{Emission factor (lb/mmBtu)} * \text{Fuel Input (mmBtu/yr)} * \text{Ton/ 2,000 lb}$$

FIGURE A-4
FORT BELVOIR
POTENTIAL EMISSIONS ESTIMATES FOR THE MILITARY POLICE STATION

EMISSIONS CALCULATIONS BASED UPON AP-42 EMISSION FACTORS

NATURAL GAS	Heat Input =	0.5 mmBtu/hr	0.0005 mmCF/hr	4.13 mmCF/yr
	Firing Rate =	472 CF/hr		
	Heat Capacity =	1,000 Btu/CF		

Pollutant Emissions	Emission Factors ^{*1,*2}	Emission Rate (lb/hr)	Actual Emissions (tons/year)
	Natural Gas (lb/mmCF)		
VOC	5.5	0.00	0.01
NO _x	100.0	0.05	0.21
CO	84.0	0.04	0.17
SO ₂	0.6	0.00	1.24E-03
PM/PM ₁₀	7.6	0.00	0.02
Lead	5.0E-04	2.36E-07	1.03E-06

Notes:

- *1 Emission factors for natural gas combustion based upon values presented in the USEPA reference document AP-42 Section 1.4.
- *2 Emissions rates calculated based upon the following equation:

$$\text{Emission Rate (lb/hr)} = \text{Emission factor (lb/mmCF)} * \text{Heat Input (mmCF/hr)}$$

- *3 Actual emissions for both facility boilers based upon worst-case actual operating scenario (i.e. natural gas or fuel oil) for anticipated actual boiler utilization using the following equations:

$$\text{Actual Emissions (tons/year)} = \text{Emission factor (lb/mmCF)} * \text{Heat Input (mmCF/yr)} * (\text{ton}/2000 \text{ lb})$$

- *4 Actual fuel usage estimated based upon square footage of project.
- *5 MP Station load based upon maximum installed heating capacity.
- *6 Heat input calculated based upon the following equation:

$$\text{Heat input (mmBtu/hr)} = 497,488 \text{ KJ} * (\text{Btu}/1055\text{J}) * (1000\text{J}/\text{KJ}) * (\text{mmBtu}/1,000,000\text{Btu}) * 100\% \text{ Utilization}$$

FIGURE A-5
FORT BELVOIR
POTENTIAL EMISSIONS ESTIMATES FOR CHAPEL

EMISSIONS CALCULATIONS BASED UPON AP-42 EMISSION FACTORS

NATURAL GAS Heat Input = 4.3 mmBtu/hr 0.0043 mmCF/hr 37.76 mmCF/yr
 Firing Rate = 4,310 CF/hr
 Heat Capacity = 1,000 Btu/CF

Pollutant Emissions	Emission Factors ^{*1,*2}	Emission Rate (lb/hr)	Actual Emissions (tons/year)
	Natural Gas (lb/mmCF)		
VOC	5.5	0.02	0.10
NO _x	100.0	0.43	1.89
CO	84.0	0.36	1.59
SO ₂	0.6	0.00	1.13E-02
PM/PM ₁₀	7.6	0.03	0.14
Lead	5.0E-04	2.16E-06	9.44E-06

Notes:

- *1 Emission factors for natural gas combustion based upon values presented in the USEPA reference document AP-42 Section 1.4.
- *2 Emissions rates calculated based upon the following equation:

$$\text{Emission Rate (lb/hr)} = \text{Emission factor (lb/mmCF)} * \text{Heat Input (mmCF/hr)}$$

- *3 Actual emissions for both facility boilers based upon worst-case actual operating scenario (i.e. natural gas or fuel oil) for anticipated actual boiler utilization using the following equations:

$$\text{Actual Emissions (tons/year)} = \text{Emission factor (lb/mmCF)} * \text{Heat Input (mmCF/yr)} * (\text{ton}/2000 \text{ lb})$$

- *4 Actual fuel usage estimated based upon square footage of project.
- *5 Chapel load based upon the Fort Hamilton, NY heating loads.
- *6 Heat input calculated based upon the following equation:

$$\text{Heat input (mmBtu/hr)} = 20,000 \text{ ft}^2 * 215.5 \text{ Btu/hr/ft}^2 * (\text{mmBtu}/1,000,000\text{Btu}) * 100\% \text{ Utilization}$$

FIGURE A-6
FORT BELVOIR
POTENTIAL EMISSIONS ESTIMATES FOR THE SOLDIER SUPPORT CENTER

EMISSIONS CALCULATIONS BASED UPON AP-42 EMISSION FACTORS

NATURAL GAS Heat Input = 14.4 mmBtu/hr 0.0144 mmCF/hr 126.48 mmCF/yr
 Firing Rate = 14,439 CF/hr
 Heat Capacity = 1,000 Btu/CF

Pollutant Emissions	Emission Factors ^{*1,*2}	Emission Rate (lb/hr)	Actual Emissions (tons/year)
	Natural Gas (lb/mmCF)		
VOC	5.5	0.08	0.35
NO _x	100.0	1.44	6.32
CO	84.0	1.21	5.31
SO ₂	0.6	0.01	0.04
PM/PM ₁₀	7.6	0.11	0.48
Lead	5.0E-04	7.22E-06	3.16E-05

Notes:

- *1 Emission factors for natural gas combustion based upon values presented in the USEPA reference document AP-42 Section 1.4.
- *2 Emissions rates calculated based upon the following equation:

$$\text{Emission Rate (lb/hr)} = \text{Emission factor (lb/mmCF)} * \text{Heat Input (mmCF/hr)}$$

- *3 Actual emissions for both facility boilers based upon worst-case actual operating scenario (i.e. natural gas or fuel oil) for anticipated actual boiler utilization using the following equations:

$$\text{Actual Emissions (tons/year)} = \text{Emission factor (lb/mmCF)} * \text{Heat Input (mmCF/yr)} * (\text{ton}/2000 \text{ lb})$$

- *4 Actual fuel usage estimated based upon square footage of project.
- *5 Soldier Support Center Load based upon the Fort Hamilton, NY heating loads.
- *6 Heat input calculated based upon the following equation:

$$\text{Heat input (mmBtu/hr)} = 67,000 \text{ ft}^2 * 215.5 \text{ Btu/hr/ft}^2 * (\text{mmBtu}/1,000,000\text{Btu}) * 100\% \text{ Utilization}$$

FIGURE A-7
EMISSION ESTIMATES FOR CONSTRUCTION ACTIVITIES

Type (number)	Hours of Operation	Horse power (HP)	Load Factor (%)	Emission Factor (grams/HP-hr)		Emissions (tons)	
				VOC	NOx	VOC	Nox
Site/Civil Preparation - 477,000 sg ft (46,376 sq m)(12 weeks)							
Backhoe (2)	720	77	55	1.40	10.10	0.05	0.34
Loader (2)	720	158	54	0.84	10.30	0.06	0.70
Hoeram (2)	720	161	62	1.41	11.01	0.11	0.87
Gas Engine Vibrator (1)	360	56	73	1.41	11.01	0.02	0.18
Auger-cast grout piling foundations (20 weeks)							
Crane (1)	600	194	43	1.26	10.30	0.07	0.57
Gas Engine Vibrator (1)	600	56	73	1.41	11.01	0.04	0.30
Erection of Frame - concrete griders on column lines (26 weeks)							
Crane (1)	780	194	43	1.26	10.30	0.09	0.74
Scissor Lift (2)	1,560	43	73	1.57	14.00	0.05	0.48
Concrete Flooring, Interior and Exterior Utilities, and Exterior Pavement (32 weeks)							
Scissor Lift (4)	3,840	43	46	1.57	14.00	0.13	1.17
Backhoe (3)	1,080	77	55	1.40	10.10	0.07	0.51
Loader (1)	360	158	54	0.84	10.30	0.03	0.35
Gas Engine Vibrator (2)	480	56	73	1.41	11.01	0.03	0.24
Total Building Construction Emissions						0.73	6.27

FIGURE A-8
FORT BELVOIR
POTENTIAL EMISSIONS ESTIMATES FOR PX EXPANSION

EMISSIONS CALCULATIONS BASED UPON AP-42 EMISSION FACTORS

NATURAL GAS	Heat Input =	14.9 mmBtu/hr	0.0149 mmCF/hr	130.26 mmCF/yr
	Firing Rate =	14,870 CF/hr		
	Heat Capacity =	1,000 Btu/CF		

Pollutant Emissions	Emission Factors ^{*1,*2}	Emission Rate (lb/hr)	Actual Emissions (tons/year)
	Natural Gas (lb/mmCF)		
VOC	5.5	0.08	0.36
NO _x	100.0	1.49	6.51
CO	84.0	1.25	5.47
SO ₂	0.6	0.01	3.91E-02
PM/PM ₁₀	7.6	0.11	0.49
Lead	5.0E-04	7.43E-06	3.26E-05

Notes:

- *1 Emission factors for natural gas combustion based upon values presented in the USEPA reference document AP-42 Section 1.4.
- *2 Emissions rates calculated based upon the following equation:

$$\text{Emission Rate (lb/hr)} = \text{Emission factor (lb/mmCF)} * \text{Heat Input (mmCF/hr)}$$

- *3 Actual emissions for both facility boilers based upon worst-case actual operating scenario (i.e. natural gas or fuel oil) for anticipated actual boiler utilization using the following equations:

$$\text{Actual Emissions (tons/year)} = \text{Emission factor (lb/mmCF)} * \text{Heat Input (mmCF/yr)} * (\text{ton}/2000 \text{ lb})$$

- *4 Actual fuel usage estimated based upon square footage of project.
- *5 Post Exchange load based upon the Fort Hamilton, NY heating loads.
- *6 Heat input calculated based upon the following equation:

$$\text{Heat input (mmBtu/hr)} = 138,000 \text{ ft}^2 * 215.5 \text{ Btu/hr/ft}^2 * (\text{mmBtu}/1,000,000\text{Btu}) * 100\% \text{ Utilization}$$